



**FINAL INVESTIGATION REPORT ON SERIOUS  
INCIDENT TO M/s SPICEJET LTD. BOMBARDIER  
DHC – 8 – 402 (Q-400) AIRCRAFT VT-SUL AT IGI  
AIRPORT, DELHI ON 08.11.2017**

**AIRCRAFT ACCIDENT INVESTIGATION BUREAU**

## ***FOREWORD***

*In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an accident shall be the prevention of accidents and incidents and not apportion blame or liability.*

*This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.*

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**FINAL INVESTIGATION REPORT ON SERIOUS INCIDENT TO M/s SPICEJET LTD.**  
**BOMBARDIER DHC – 8 – 402 (Q-400) AIRCRAFT VT-SUL AT IGI AIRPORT,**  
**DELHI ON 08.11.2017**

1.	Aircraft		Bombardier
		Type	DHC – 8 – 402 (Q-400)
		Nationality	Indian
		Registration	VT-SUL
2.	Owner	Maple Leaf Financing Limited	
3.	Operator	Spice Jet Limited	
4.	Pilot – in –Command	ATPL Holder	
	Extent of Injuries	None	
5.	Co-pilot	CPL Holder	
	Extent of Injuries	None	
6.	No. of Passengers on board	72	
	Extent of Injuries	None	
7.	Last point of Departure	Jabalpur Airport	
8.	Intended landing place	IGI Airport, Delhi	
9.	Place of incident	IGI Airport, Delhi	
10.	Date & Time of incident	08.11.2017 & 1442 UTC	
11.	Type of Operation	Scheduled	
12.	Phase of operation	Landing	
13.	Type of incident	Hard landing and subsequently tail strike	
14.	Coordinates of Site	28° 34' 11.75" N , 77° 06' 53.38" E	
15.	Elevation	778 Feet.	

(ALL TIMINGS IN THE REPORT ARE IN UTC)

## SYNOPSIS

On 08.11.2017, M/s Spice Jet Ltd. Bombardier DHC – 8 - 402 aircraft VT-SUL while operating a scheduled flight SG-2642, (Jabalpur-Delhi) was involved in a serious incident of hard landing and subsequent tail strike while landing at IGI airport, Delhi. The aircraft was under the command of pilot holding valid ATPL and duly qualified on type along with First Officer having a valid CPL holder and qualified on type. There were 02 cabin crew and 72 passengers on board the aircraft.

The aircraft took-off from Jabalpur at around 1307 UTC. The enroute flight was uneventful. ATC Delhi cleared the aircraft for landing on Runway 27. During descent while approaching runway 27 for landing, at 411 feet AGL the PIC after disconnecting the autopilot, inadvertently pressed the Go Around (GA) button. As the GA button was pressed, the FD bars moves to 10° on Flight Director. The PIC disregarded the bar on Flight Director (FD) and continued approach visually. During landing, there was high Rate of Descent and in order to reduce the descent, the nose of aircraft pitched up (6.3°). Aircraft made a hard landing with vertical acceleration 3.77G and subsequently had a tail strike. While taxiing to the assigned bay, the PIC observed “Touched Runway” light ‘ON’ in the cockpit panel. After the aircraft was parked on the bay, a walk around inspection carried out by the ground engineering personnel, revealed scrapping marks & dents on aft belly portion of the aircraft. There was no injury to any of the occupant on board the aircraft. There was no fire.

The Director General – AAIB appointed Sh. Amit Gupta, Director-AED as Investigator – in – Charge with Sh. K Ramachandran, Air Safety Officer, AAIB as Investigator to investigate into the cause(s) of the serious incident under Rule 11 (1) of Aircraft (Investigation of Accidents and Accidents), Rules 2017.

The probable cause of incident is “Un-stabilized approach due to improper handling of controls i.e. Inadvertent pressing of GA button and movement of throttle below flight idle resulting in heavy landing and subsequent tail strike.”

### *“Contributory factors*

- Error due to fixation to maintain Glide Slope.
- Depth perception due low visibility.
- Not carrying out go around after inadvertently pressing GA button.“

## **1. FACTUAL INFORMATION.**

### **1.1 History of the flight**

On 8<sup>th</sup> November 2017, the aircraft was scheduled to operate flight sector Delhi – Jabalpur - Mumbai – Jabalpur - Delhi – Varanasi – Delhi. The flight from Delhi to Jabalpur and then to Mumbai was operated by another set of crew. The involved crew was rostered to operate Mumbai – Jabalpur - Delhi – Varanasi – Delhi sector. The scheduled departure time for the flight from Mumbai to Jabalpur was 0840 UTC, however, the flight was delayed and the aircraft departed at around 1050 UTC from Mumbai and landed Jabalpur at 1225 UTC. As the flight was delayed, the flight crew were informed that they will not be operating Delhi – Varanasi – Delhi sector and flight from Jabalpur to Delhi will be their last flight for the day. There was no snag reported by the pilot.

The aircraft then took-off from Jabalpur for Delhi at 1307 UTC with a delay of 2 hours (1100 UTC actual time of departure). As per the statement, PIC handed over controls to co pilot from 2000 feet after takeoff from Jabalpur till 1000 ft before landing at Delhi. The enroute flight was uneventful. Thereafter, PIC took over controls and was Pilot Flying (PF). The aircraft came in contact with Delhi approach at 1440 UTC. The ATC then cleared the aircraft for landing at runway 27. The weather at that time in Delhi was visibility 400 meters and calm winds. As per the PIC statement, during approach for landing at around 500 feet AGL, they got visual contact with runway and continued the approach. At around 411 feet AGL, the PIC disengaged the autopilot and simultaneously inadvertently pressed the GA (Go Around) button. As the GA button was pressed, the FD bars moved to 10° pitch up on Flight Director. The PIC disregarded the bar on Flight Director (FD) and continued approach visually maintaining 2 red / 2 white on PAPI. As the FD bars were showing GA pitch, the PIC had no reference other than approach lights & PAPI. During landing, there was high Rate of Descent and in order to reduce the descent, PIC increased power to maintain glide slope. The PIC further stated that during approach while over threshold, the aircraft was high (above the glide slope) and in order to

correct the same, PIC reduced power. While reducing the power, the PIC lifted the lock of power lever and the power was reduced below flight idle. There was a momentary warning sound in the cockpit for the same. This reduction in power further increased the rate of descent and in order to flare the aircraft, pitch attitude was increased. The PIC had a depth perception due low visibility (400 meters) and flared the aircraft late. The aircraft made a hard landing with subsequent tail strike. After landing on runway 27, the aircraft was given taxi instructions to bay. While taxiing the aircraft to bay, the PIC observed the 'TOUCHED RWY' warning light illuminated on the overhead caution & warning lights panel. After parking the aircraft at the assigned bay, the PIC instructed the cabin crew to call the AME on board. The PIC discussed the event with AME and informed that 'TOUCHED RWY' light illuminated after touchdown. All passengers were deplaned normally. As per cabin crew statement "at the time of landing, felt bump in the cabin. Felt landing was hard". The cockpit crew did not inform ATC about the incident. There was no injury to any of the occupant on board the aircraft and there was no fire. The aircraft was grounded after the incident and released for flights after major repairs.

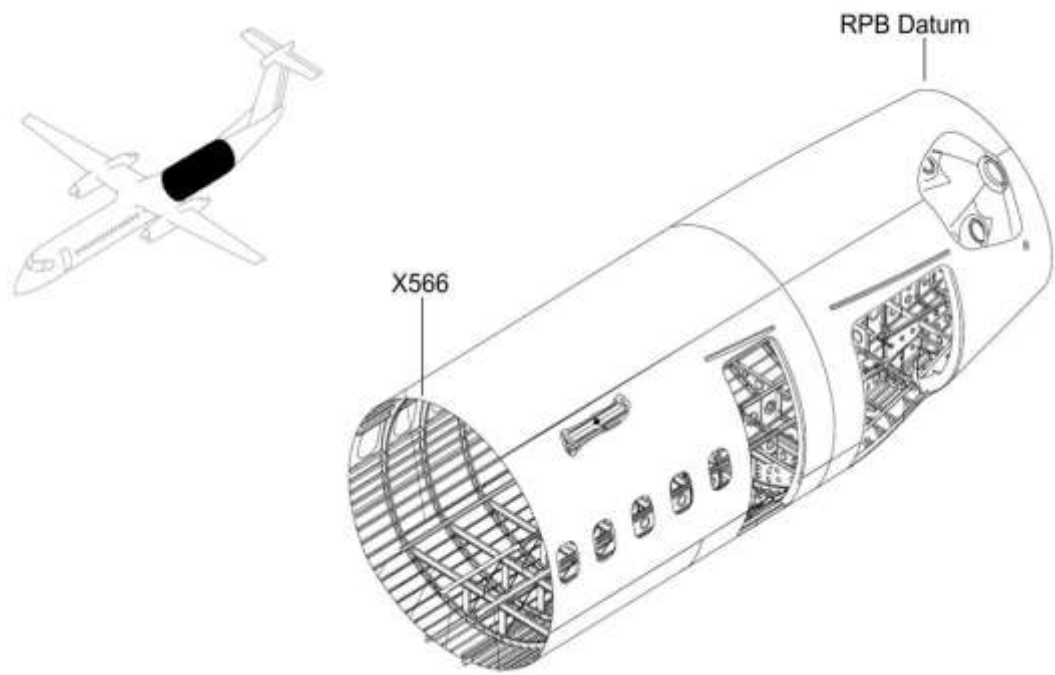
## 1.2 Injuries to persons.

<b>INJURIES</b>	<b>CREW</b>	<b>PASSENGERS</b>	<b>OTHERS</b>
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
<del>MINOR</del> /None	02+02	72	

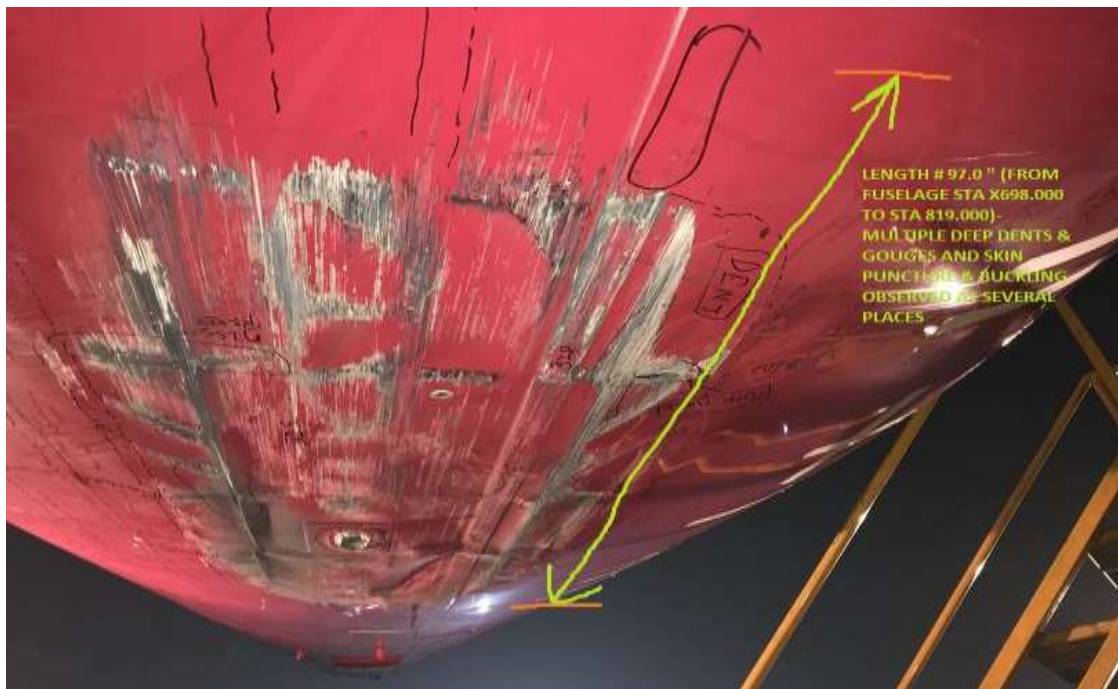
## 1.3 Damage to aircraft.

The aircraft sustained damages confined to aft center fuselage & its structural components. Few of the damages observed are as below:-





***Aft Centre Fuselage Section***

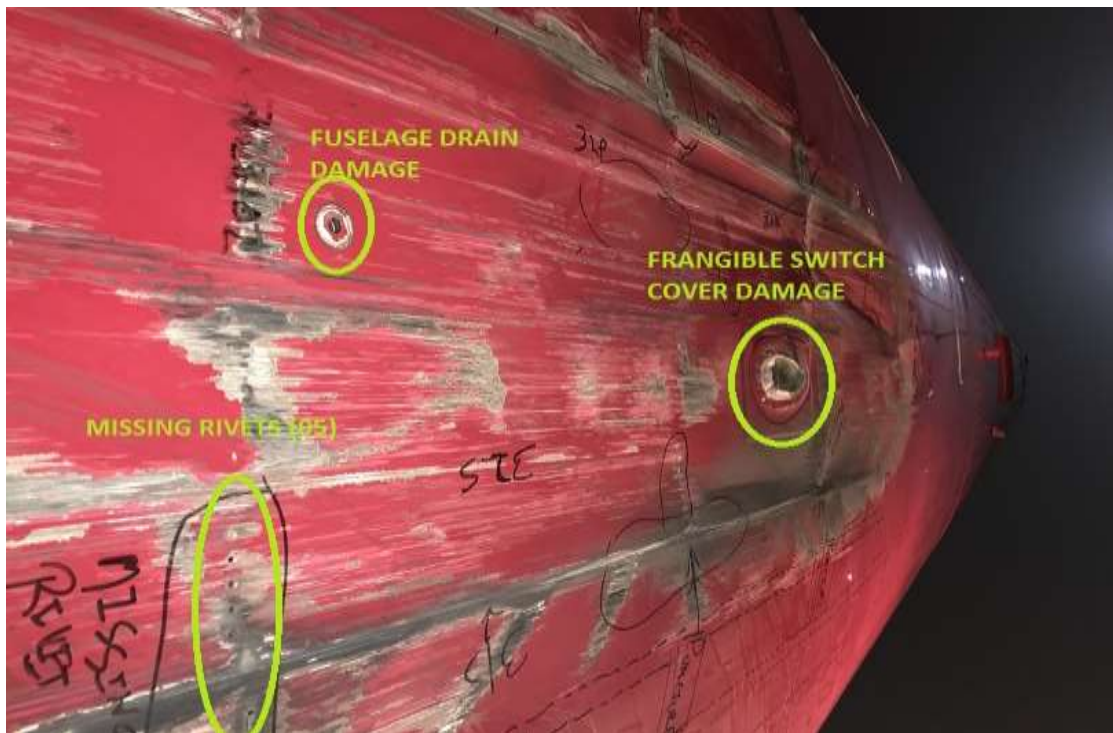


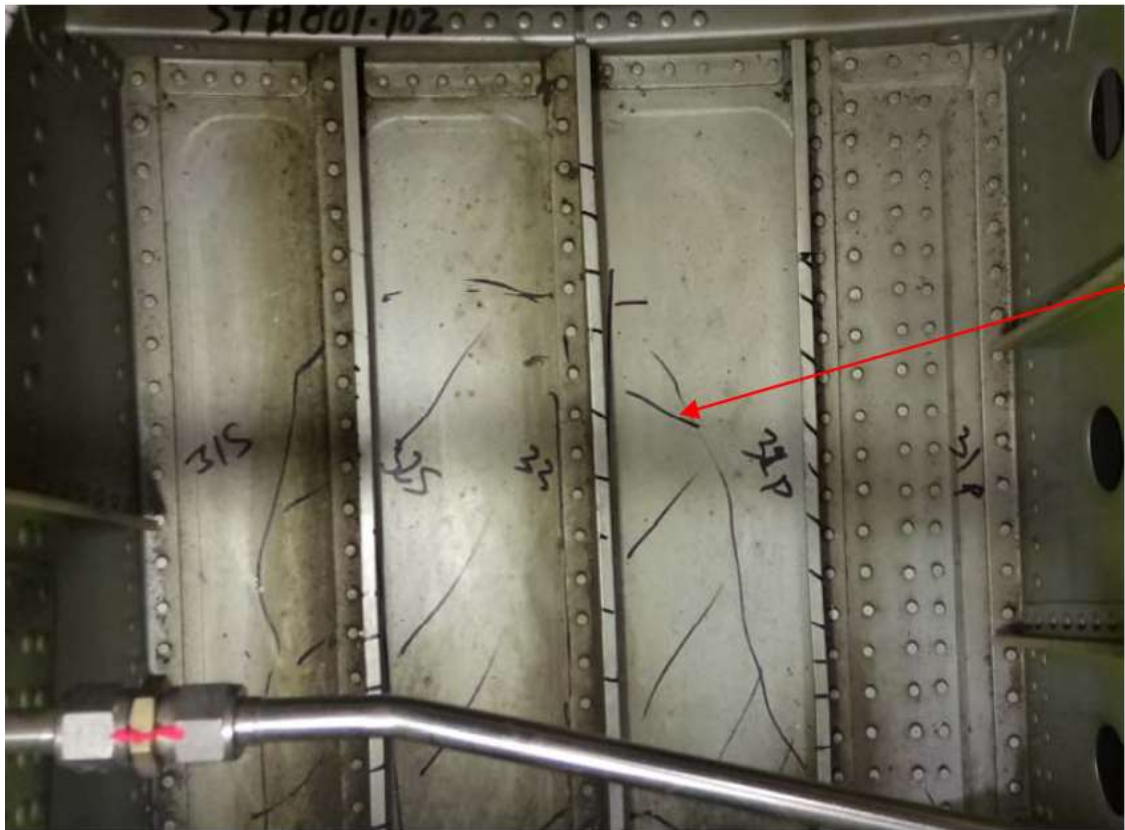
- Lower surface skin received heavy scrape marks, cracks, buckles, tears and crease damages between cross section 697.5 to 801 and between stringers 29P to 29S.



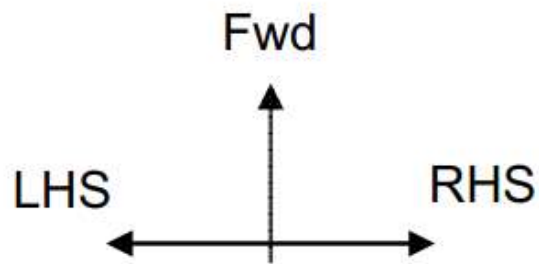
**Heavy Scrape marks on lower surface**

- The Frangible Switch Cover was found missing
- Fuselage Drain was found damaged.
- Few rivets were found missing between cross section 698 & 801

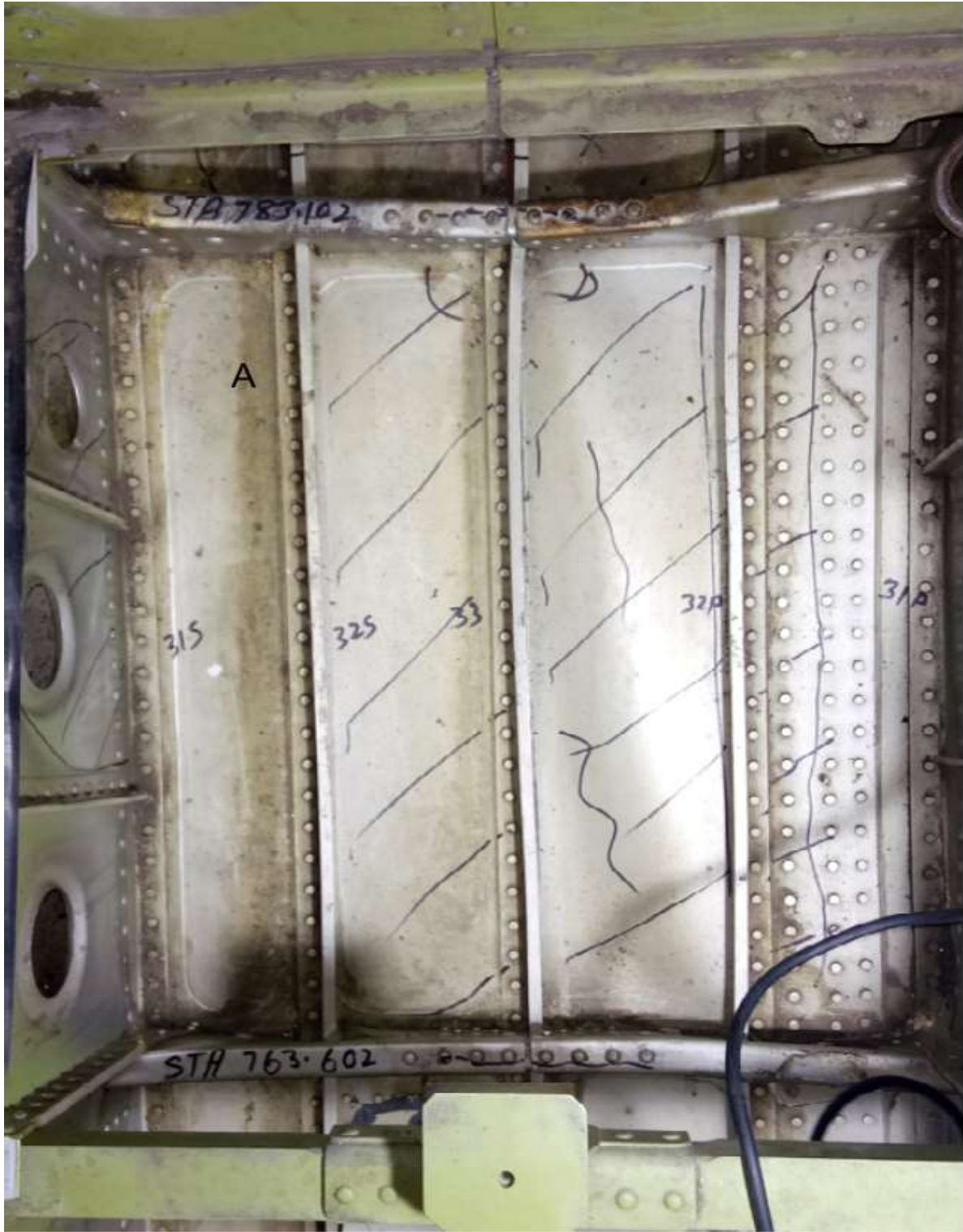




***Skin deflection and Stringer Buckling damage forward of Frame X801.102***



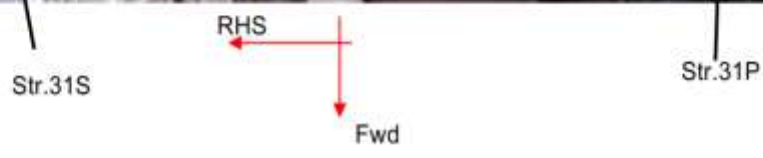
***Buckling damage at Frame X783.602***



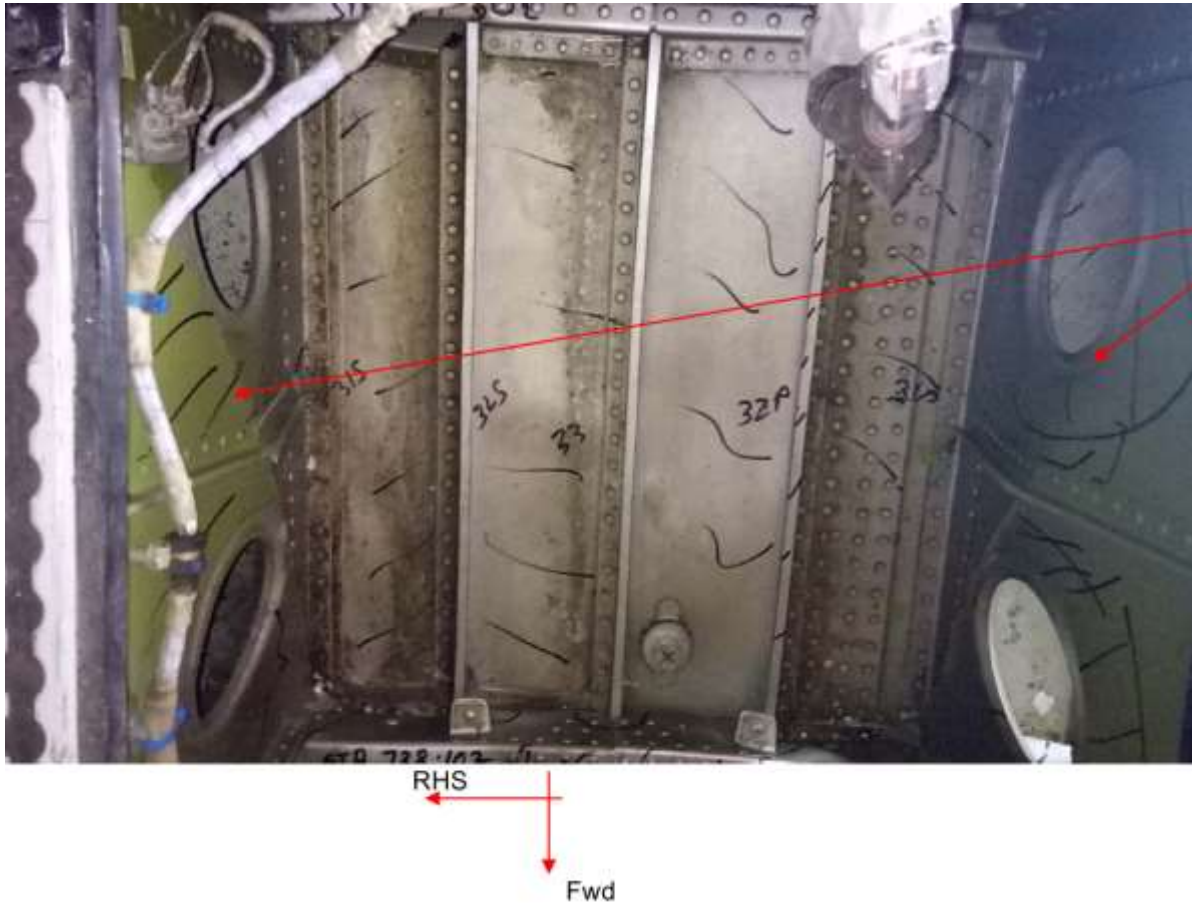
**Skin and Stringer damage between Station 783.602 & 763.602**



**RH Stringer 31S Keel Web Damage**



**Skin and Stringer damage between Station 747.602 & 763.602**



***RH (Stringer 31S) & LH (Stringer 31P) Keel Web Damage***

#### **1.4 Other damage**

Nil

#### **1.5 Personnel information**

##### **1.5.1 Pilot- in- Command**

AGE	37 years.
License Type	ATPL holder.
Date of issue & Validity	29.11.2016 & valid on the day of incident.
Category	Multi Engine Land.
Type endorsements	Cessna – 172, Piper Seneca PA34, DHC -8-402
Aircraft rating	DHC-8-402
Date of Joining Company	19.09.2011
Instrument Rating Validity	27.02.2018
FRTOL validity	27.04.2019
RTR	11.11.2018
Date of last Medical Examination &	24.04.2017 & valid on the day

Validity	of incident.
Date of Last Line/Route Check & validity	28.04.2017 & valid on the day of incident.
Date of last English language Proficiency	30.12.2011
Date of Last CRM Training	10.02.2017
Date of last Monsoon Training	11.05.2017
Date of last Simulator Refresher/Test (LVTO)	03.03.2017
Date of Refresher & validity	10.02.2017 & valid on the day of incident
Date of AVSEC & validity	10.05.2016 & valid on the day of incident
Date of SEP training & validity	10.02.2017 & valid on the day of incident
Total flying Experience	2786:58 Hrs
Total Experience on Type as PIC	470:31 Hrs
Total Experience on Type as Co-Pilot	2068:59 Hrs
For Last 1 Year	703:22 Hrs
Total in last 90 days	219:31 Hrs
For Last 30 days	102:04 Hrs
For Last 7 days	25:07 Hrs
For the last 24 hrs	05:45 Hrs
Rest Period Prior to Duty Flight	24 Hours
Check Pilot Rating	Nil

### 1.5.2 Co- Pilot

AGE	32 years.
License Type	CPL holder.
Date of issue & Validity	28.08.2008 & valid on the day of incident.
Category	Multi Engine Land.
Type endorsements	Cessna – 172, Duchess -76, DHC -8-402
Aircraft rating	DHC-8-402
Date of Joining Company	29.09.2016

Instrument Rating Validity	05.02.2019
FRTOL validity	02.11.2019
RTR	24.02.2018
Date of last Medical Examination & Validity	29.08.2017 & valid on the day of incident.
Date of Last Line/Route Check & validity	24.03.2017 & valid on the day of incident.
Date of last Proficiency---IR Check	06.02.2017
Date of last English language Proficiency	01.09.2017
Date of Last CRM Training	20.02.2017
Date of last Monsoon Training	20.02.2017
Date of last Simulator Refresher / Test	08.08.2017
Date of Refresher & validity	20.02.2017 & valid on the day of incident
Date of AVSEC & validity	10.10.2016 & valid on the day of incident
Date of SEP training & validity	20.02.2017 & valid on the day of incident
Total flying Experience	921:13 Hrs
Total Experience on Type as PIC	Nil
Total Experience on Type as Co-Pilot	692:24 Hrs
For Last 1 Year	692:24 Hrs
Total in last 90 days	228:52 Hrs
For Last 30 days	100 Hrs
For Last 7 days	20 Hrs
For the last 24 hrs	05:45 Hrs
Rest Period Prior to Duty Flight	24 Hours
Check Pilot Rating	Nil

Both the operating crew was not involved in any serious incident or accident in the past.



## **1.6 Aircraft information**

### **1.6.1 General information**

Aircraft VT-SUL (MSN 4400) was manufactured in year 2012. The aircraft was registered with DGCA under the ownership of M/s Maple Leaf Financing Limited. The aircraft is registered under Category 'A' and the certificate of Registration Number 4337.

The Certificate of Airworthiness Number 6446 under "Normal category" subdivision Passenger / Mail / Goods was issued by DGCA on 30<sup>th</sup> June 2012. The specified minimum operating crew is two and the maximum all up weight is 29257 Kgs. At the time of incident, the Certificate of Airworthiness was valid. The Aircraft was holding a valid Aero Mobile License No. A-010/048-RLO (NR) at the time of incident. This Aircraft was operated under Scheduled Operator's Permit No S-16 which was valid up to 16th May 2018. As on 08.11.2017, the aircraft had logged 15591:31 Airframe hours and 15265 cycles.

The Bombardier DHC-8-402 aircraft and its engines are being maintained as per the Maintenance Programme consisting of calendar period / flying Hours or Cycles based maintenance as per Maintenance Programme approved by Regional Airworthiness Office, Delhi. Accordingly, the last Major Inspection 'C' Check was carried out at 11597 cycles on 20th August 2016. Subsequently, all lower inspection were carried out as and when due before the incident.

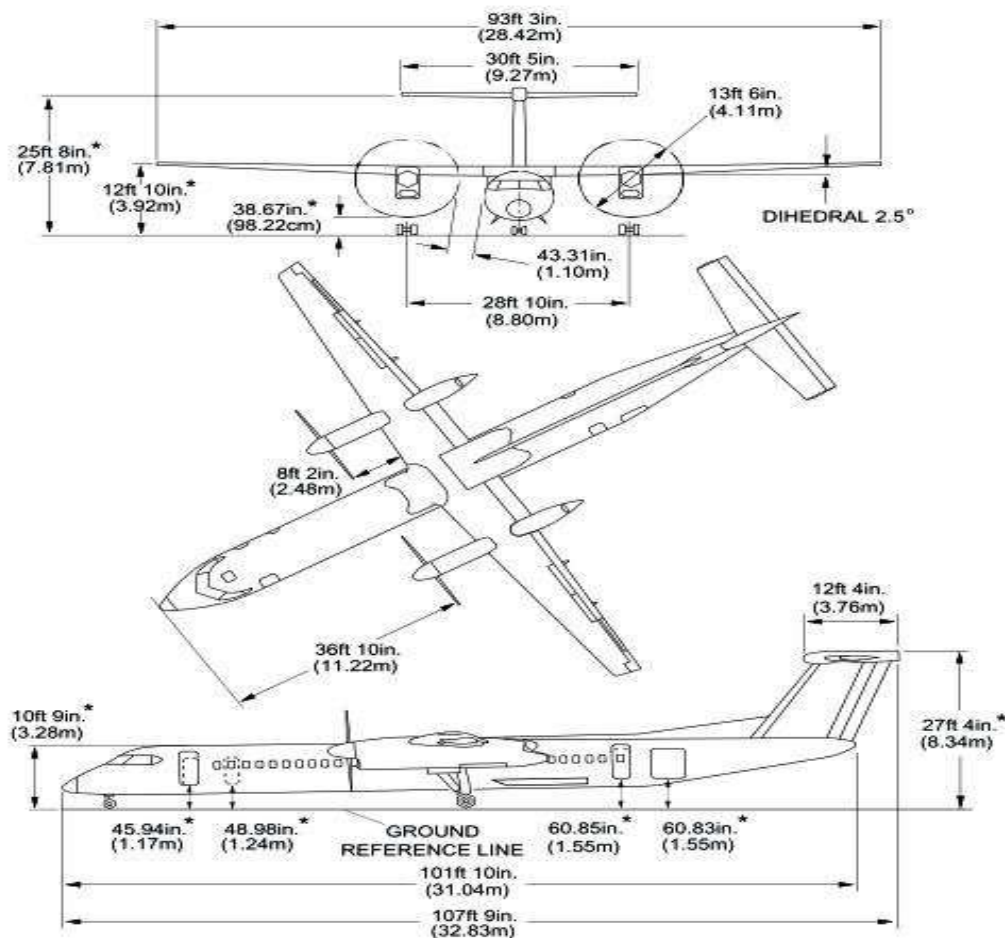
The aircraft was last weighed on 19th February 2017 at Delhi and the weight schedule was prepared and duly approved by the office of Director of Airworthiness, DGCA, Delhi. As per the approved weight schedule, the Empty weight of the aircraft is 17695.61 Kgs. Maximum payload with fuel tanks full is 5665.59 Kgs. Empty weight CG is 9.99 meters aft of datum. There was not any major modification affecting weight & balance since last weighing, hence the next weighing was due on 19<sup>th</sup> February 2022. Prior to the incident flight, the weight and balance of the aircraft was well within the operating limits.

All related Airworthiness Directives, mandatory Service Bulletins, DGCA Mandatory Modification on this aircraft and its engines have been complied with as on date of incident. Transit Inspections are carried out as per approved Transit Inspection Schedules and other higher Inspection Schedules include Checks 1 Inspection as per the manufacturer's guidelines as specified in Maintenance Programme and are approved by the Continuous Airworthiness Manager (Post Holder for Continuous Airworthiness).

The last fuel microbiological test was done through Fuel stat test kit on 28th December 2016 at Delhi by Spicejet and the microbiological growth was negligible.

The Aircraft is fitted with two Pratt & Whitney PW 150 A engines. The left Engine S/N PCE-FA0836 had logged 14333.30 Hrs / 13818 cycles and the right Engine S/N PCE-FA0867 had logged 12735.43 Hrs / 12430 cycles.

### 1.6.2 DHC – 8 402 Aircraft Description



**3-View diagram of DHC-8**

The aircraft is a metal high wing monoplane with fully cantilever wings and horizontal stabilizer surfaces, a semi-monocoque fuselage and a fully retractable tricycle landing gear. A large portion of the skin panels are bonded assemblies consisting of skin, stringers and doublers, or skin sandwich with a honeycomb core.

The two nacelles, one on each side of the fuselage, mounted below the wing, house the power plants and accommodate the landing gears and some additional equipment. The nacelle comprises following three main areas of structure i.e. Forward, Centre and Aft. The center nacelle structure which is located between nacelle stations 121.230 and 210.000, houses A-Frame which attaches to MLG drag-strut and side-braces. The A-Frame is machined from a solid aluminum alloy billet.

### **Landing Gear**

The landing gear is electrically controlled and hydraulically operated. The tricycle gear is a retractable dual wheel installation. The main gears retract aft into the nacelles and the nose gear retracts forward into the nose section. Doors completely enclose the landing gear when it is retracted and partially enclose the gear when it is down.

The normal pitch attitude of the DHC-8-402 in landing configuration with the flaps at 15° is 3.5° nose-up on a 3° final approach path at VREF.

The manufacturer has determined that the pitch attitude required for the aircraft tail to make contact with the runway is dependent on main gear strut extension as follows:-

- With struts fully extended, the pitch angle is approximately 10.2°, assuming zero runway crown;
- With struts fully compressed, the pitch angle is approximately 6.9°, assuming zero runway crown; and
- A runway crown may reduce the pitch angle by up to 0.5°.

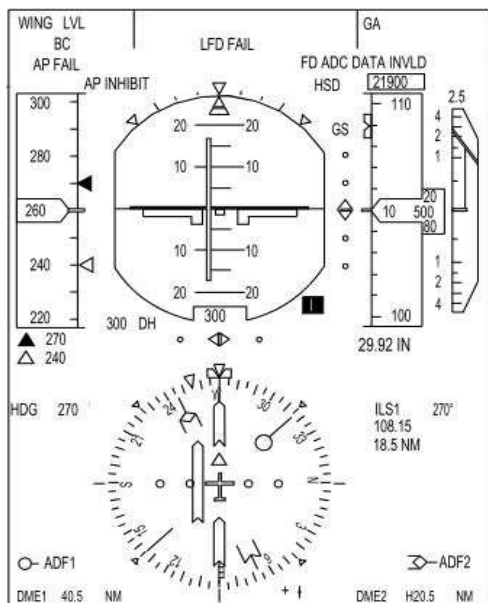
### 1.6.3 The Automatic Flight Control System (AFSC) - Flight Director (FD)

The Automatic Flight Control System (AFCS) provides fail-safe operation of flight director guidance, autopilot, yaw damper and automatic pitch trim functions. The AFCS provides dual Flight Director capability, a single Autopilot and a single Yaw Damper. The AFCS is designed to provide all weather approach capability to Category I and II limits for ILS and Category I limits for MLS, if optional MLS receivers are installed on the aircraft. The AFCS is also capable of non-precision VOR approaches, front and back course Localizer approaches, MLS Azimuth approaches and FMS approaches.

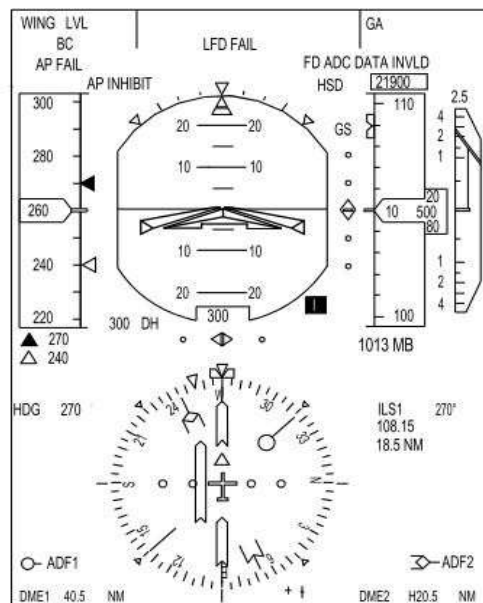
The Flight Director (FD) provides aircraft lateral and vertical guidance which is:

- Displayed on the PFDs (Primary Flight Display) for the pilot to manually control the aircraft.
- Coupled to the Autopilot for automatic control of the aircraft.

FD mode selections are performed using inputs from the Flight Guidance Control Panel and the Go Around mode switches. Pitch and roll commands are displayed as the Flight Director bars on the PFD. The FD commands are displayed in either a single cue format or a cross bar pointer format on the PFD. Selection between the two FD display options is determined by the Aircraft Configuration Module.



**Cross Bar Pointer Format**



**Single Cue Format**

### 1.6.3.1 Flight Director Modes

#### Go Around Mode

The Go Around mode is normally used to transition from an approach to a climb out for a missed approach, but can be selected at any time.

The flight crew selects Go Around mode by pressing either of the two Go Around switches located on the power levers. When Go Around is selected, the following occurs:-

- The AP disengages.
- The FD vertical mode transitions to Go Around mode, which commands a fixed pitch angle of 10°.
- The FD lateral mode transitions to the Wings Level sub-mode, which commands zero roll attitude.
- All FD armed modes are disarmed.



***FD Display of Q 400 aircraft***

The Go Around mode is deactivated by:-

- Activating any other vertical mode, either manually or automatically.
- Engaging the AP.

- Selecting STBY or HSI SEL.
- Changing the selected ADC (Air Data Computer) or AHRS (Attitude and Heading Reference System) source.

Selecting a lateral FD mode other than Wings Level does not deactivate Go Around.

Selecting TCS in Go Around mode does not modify the Go Around pitch target, and does not deactivate Go Around mode. Upon TCS release, the FD lateral mode may transition from the Wings Level submode to the Roll Hold sub-mode of the Lateral Basic mode, depending upon the aircraft bank angle.

The Go Around mode is deactivated and inhibited from activation by:-

- A failure of CAS or TAS data from the selected ADC (this disengages the FD).
- A failure of attitude data from the selected AHRS (this disengages the FD)

#### **Tactile Control Steering (TCS) Mode**

The flight crew operates the TCS mode by pressing a Tactile Control Steering switch, located on both the pilot's and co-pilot's control columns. If the Autopilot is engaged, the pitch and roll AP actuators automatically declutch and the actuator monitoring is inhibited, allowing the pilot manual control of the pitch and roll flight controls with normal control forces and without disengaging the Autopilot.

#### **1.6.3.2 Flight Guidance Mode Selectors (momentary action)**

**PUSH** - selects flight director modes of operation

- flight director command bars display lateral and vertical guidance commands depending on selected mode
- pilot can manually fly the displayed commands or engage the AP to automatically fly the commands
- the selected flight director mode appears in the Flight Mode Annunciator (FMA) area of each PFD

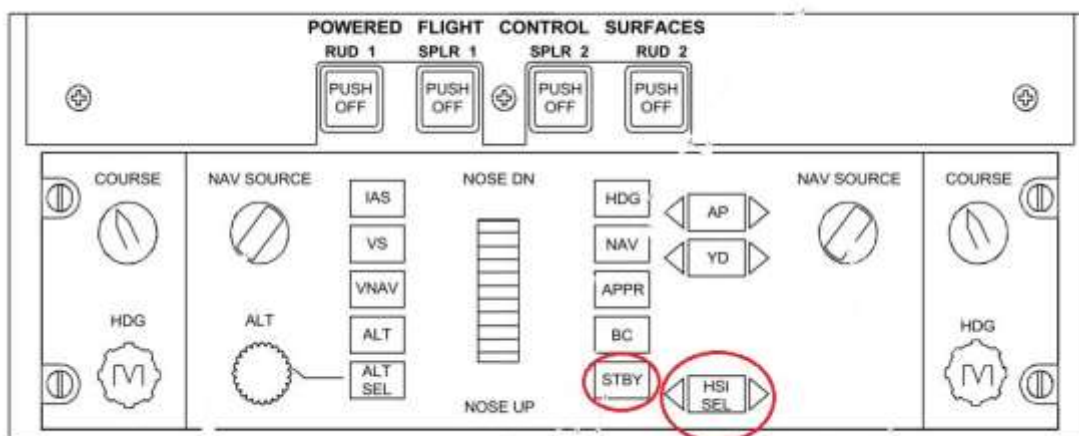
## HSI SEL (momentary action)

### **Pointer segments (white)**

PUSH - the HSI SEL pushbutton selects which PFD (1 or 2) the FD is coupled to. The PFD set of parameters used include: NAV source, course targets, HDG targets and ADU / AHRS

- pressing the HSI SEL pushbutton switches from the left NAV SOURCE, HDG, COURSE and ADU / AHRS selections displayed on the pilot's PFD, to the right NAV SOURCE HDG, COURSE and ADU / AHRS selections displayed on co-pilot's PFD, and vice-versa.
- the selected side is indicated by lighting the corresponding arrow next to the HSI SEL pushbutton on the FGCP. The selected side is also indicated on the non-selected PFD by an HSI plus an arrow
- if the Dual FD mode is active, both the left and right arrows on either side of the HSI SEL pushbutton are lit, and pressing the HSI SEL push button has no effect
- pressing the HSI SEL pushbutton has the following effects on the AFCS:
  - No effect on AP / YD engagement
  - Clears all active and armed lateral and vertical FD modes and removes the FD bars if the AP is not engaged
  - Clears all active and armed lateral and vertical FD modes if the AP is selected (reverts to basic mode) (FD bars remain)

Upon power-up, the HSI Selection defaults to the left side.



***Flight Guidance Control Panel***

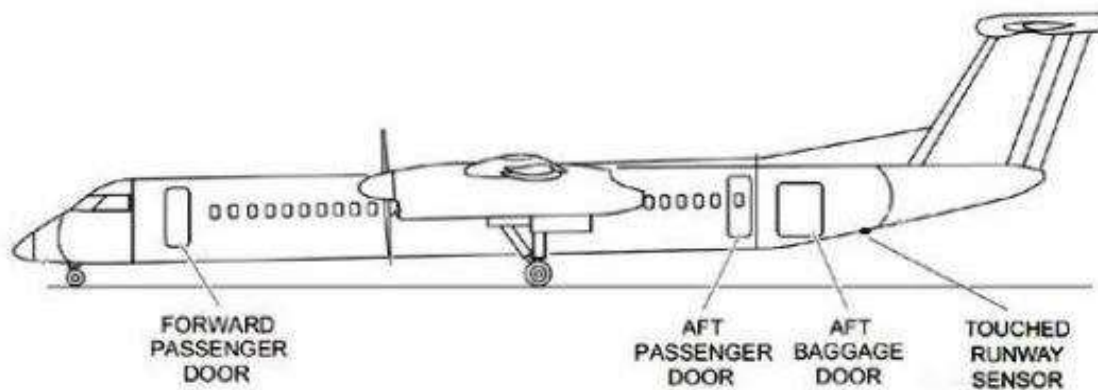
### **STBY MODE (momentary action)**

**PUSH** - pressing the STBY pushbutton has the following effects on the AFCS:

- No effect on AP / YD engagement
- Clears all active and armed lateral and vertical FD modes and removes FD bars if the AP is not engaged.
- Clears all active and armed lateral and vertical FD modes if the AP is engaged (reverts to basic mode).
- Clears FD abnormal messages.

### **1.6.4 Touched Runway (Tail touch/strike) Indication in Cockpit**

The Dash 8-400 is fitted with a touched runway detection system that includes a frangible switch/sensor located on the underside of the aft fuselage. In the event of a tail strike, a TOUCHED RUNWAY warning light, located on the overhead warning light panel in the cockpit, illuminates.



***Touched runway sensor located at aft fuselage lower surface***



***Touched runway light in overhead warning light panel in cockpit***



At touchdown, depending on main gear oleo compression and curvature of the runway surface, tail contact will occur at between 6.9° and 7.5° nose up. As per Aircraft Flight Manual while landing if fuselage contact with runway i.e. TOUCHED RUNWAY warning light illuminates may be due to the possibility of runway debris following actions needs to be carried out:

1. Advise ATC and airport operations of the fuselage/runway contact.
2. Aircraft must not be flown prior to inspection and maintenance approval.

#### **1.6.4.1 Caution & Warning Lights System Description**

The caution and warning light system in the aircraft shows system malfunctions and other conditions that require a corrective action. The warning lights are red in colour which shows system malfunctions or the conditions that cause dangerous flight conditions. It shows a condition or malfunction which requires immediate corrective action.

There are five different types of inputs to the caution and warning panel:

- Type I, supplied 28 V dc
- Type II, supplied ground
- Type III, 28 V dc removed
- Type IV, ground removed
- Type V, combination.

Type I: A malfunction condition is present if the input to the caution and warning panel is more than 10 V dc.

Type II: A condition is present if the impedance to ground potential is less than 50 W.

Type III: A condition is present if the input to the caution and warning panel is less than 10 V dc.

Type IV: A condition is present if the impedance to ground potential is more than 2000 W or if the total voltage across a switching element and a 50 W resistor is more than 4.5 V dc.

Type V: A condition is present if the input is a combination of type I, II, III, or IV inputs.

There are five other control inputs from the caution and advisory lights toggle switches to the caution and warning panel:

- Master warning reset, 28 V dc
- Master caution reset, 28 V dc
- Test, 28 V dc
- Dim, 28 V dc
- Bright, 28 V dc.

A system malfunction or condition causes its related advisory annunciator to come on. The annunciator stays in view until the malfunction or condition is corrected.

There are two different types of inputs from the caution and advisory lights toggle switches to the caution and warning panel:

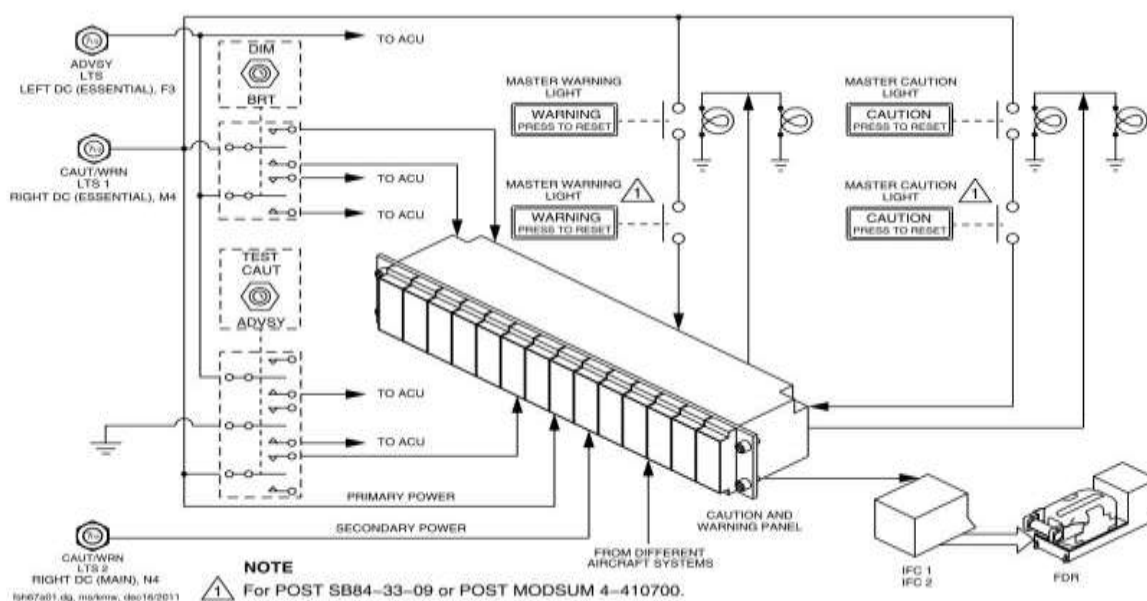
- Type I, supplied 28 V dc
- Type II, supplied ground

Type I: A condition is present if the input to the ACU is more than 10 V dc.

Type II: A condition is present if the impedance to ground potential is less than 50 W.

There are three other control inputs to the ACU:

- Test, 28 V dc
- Dim, 28 V dc
- Bright, 28 V dc.



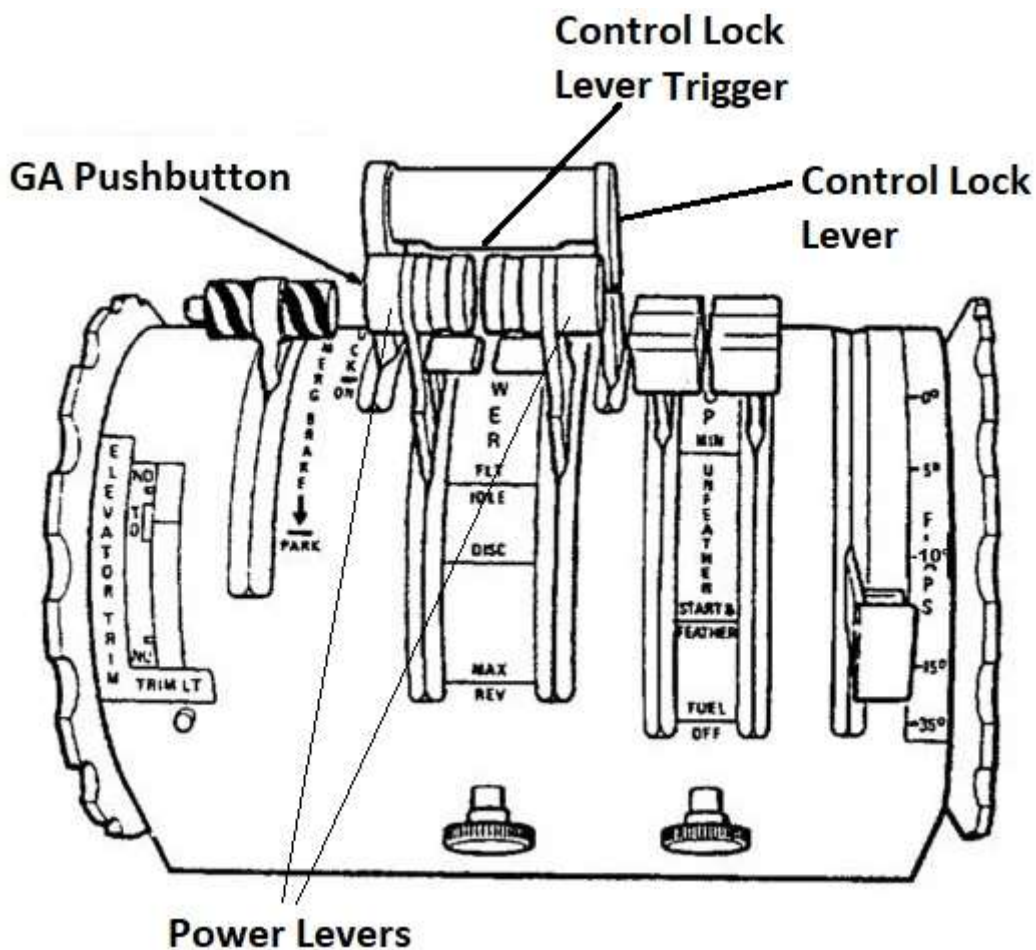
**Caution & Warning Lights System Block Diagram**

The warning light indications at the bottom row of the caution and warning panel is summarized in the table below.

Annunciator	Panel Location	Cause for Illumination
WARNING PRESS TO RESET		Comes on flashing with a flashing warning annunciator.
WARNING PRESS TO RESET		Comes on flashing with a flashing warning annunciator.
CABIN PRESS		Cabin altitude is more than 10,000 ft. (3.05 km).
CHECK FIRE DET		Engine fire, APU fire, or detector loop circuit malfunction is sensed.
SMOKE		Smoke is sensed in baggage area.
TOUCHED RUNWAY		Rear outer fuselage surface below pressure bulkhead has touched the runway during landing or take-off.
#1 ENG OIL PRESS		No. 1 engine oil pressure is less than 42 psi (289.58 kPa).
#1 ENG FADEC FAIL		No. 1 Full Authority Digital Engine Control has malfunctioned.

Annunciator	Panel Location	Cause for Illumination
#2 ENG FADEC FAIL		No. 2 full authority digital engine control has malfunctioned.
#2 ENG OIL PRESS		No. 2 engine oil pressure is less than 42 psi (289.58 kPa).
STBY BAT HOT		Battery temperature is more than 71 °C (160 °F).
AUX BAT HOT		Battery temperature is more than 71 °C (160 °F).
MAIN BAT HOT		Battery temperature is more than 71 °C (160 °F).
FUSELAGE DOORS		One or more fuselage doors are not closed.

### 1.6.5 Power lever, Go Around Switch & Control Lock Lever.



Go-Around switches are pushbuttons situated on both sides (of #1 & #2 power levers) of the power lever handle. The control lock Lever can be locked in two positions i.e. OFF & ON. The control lock lever cannot be moved unless the control lock lever trigger is pressed.

If the throttle lever is not properly handled, the GA button may be pressed by the thumb.

### 1.7 Meteorological information

The following is the Met report of New Delhi IGI Airport on the date of incident between 1330 UTC to 1530 UTC.

Time (UTC)	Winds (°/Knots)	Visibility (Meters)	Weather	Clouds	QNH (hPa)	Temp (°C)	Dew Point (°C)	RVR Rwy 27 (Meters)
1330	Calm	400	FU (Smoke)	No Significant Change (NSC)	1013	23	16	1100
1400	Calm	400	FU	NSC	1013	22	16	1100
1430	Calm	400	FU	NSC	1014	21	16	1100
1500	Calm	400	FU	NSC	1014	21	16	1100
1530	Calm	400	FU	NSC	1014	20	15	1000

### 1.8 Aids to navigation

The IGI Airport, New Delhi has 03 runways and are equipped with NDB, DVOR, ILS CAT-I, CAT-II, CAT-IIIA, CAT-IIIB, ASMGCS, SMR.

### 1.9 Communications

There was always two-way communication between the ATC and the aircraft. At the time of incident, the aircraft was under Delhi ATC.

### 1.10 Aerodrome Information

The aircraft landed on runway 27 of IGI Airport, New Delhi. The details of the IGI airport New Delhi are as follows:

### Co-ordinates

ARP : N 28° 34' 07"  
E 077° 06' 44"  
Elevation : 778 Feet.

### Runway Orientation and Dimension

Orientation - 10/28 Dimension 3810 x 45 Meters  
11/29 Dimension 4430 x 60 Meters  
09/27 Dimension 2813 x 45 Meters

### Approach and Runway Lighting

RWY.	APCH LGT	THR LGT	PAPI	Rwy Centre Line LGT	RWY edge LGT
09	SALS	Yes	Yes	Yes	Yes
27	CAT-I	Yes	Yes	Yes	Yes
10	CAT-I	Yes	Yes	Yes	Yes
28	CAT IIIB	Yes	Yes	Yes	Yes
11	CAT IIIB	Yes	Yes	Yes	Yes
29	CAT IIIB	Yes	Yes	Yes	Yes

### ATS Airspace:

- Designation Delhi CTR. 30 NM centered at DPN VOR
- Vertical Limits SFC to FL50
- Airspace Classification D
- Transition Altitude 4000 FT MSL

Fire Fighting Services: CAT – 10

Met Office Hour of service is 24 Hrs. TAF, Trend Forecast and Briefing is available.

### Navigation and Landing Aids

NDB, DVOR, ILS CAT-I, CAT-II, CAT-IIIA, CAT-IIIB, ASMGCS, SMR

### ATS Communication Facilities

Delhi Radar 119.3/127.9 MHZ  
Delhi Flow Control 119.5 MHZ  
Delhi Approach 119.3/127.9 MHZ  
Delhi Approach/Radar 124.2/124.25/124.6/125.675/125.85 MHZ

Delhi Tower	118.1/118.25/118.75/118.825 MHZ
DATIS	126.4 MHZ
Delhi Ground	121.625/121.75/121.9 MHZ

### **1.11 Flight Recorders**

The aircraft was fitted with Universal Solid State CVR & DFDR. The Cockpit Voice Recorder (CVR) and the Digital Flight Data Recorder (DFDR) were downloaded after the incident and the following information was obtained.

#### **1.11.1 Cockpit Voice Recorder**

A total of last 02:02:45 hours of recording were available in CVR. The CVR recording was synchronized with the ATC tape to get the approximate time of call outs. Following are the salient observations:

- At 144030 UTC - the aircraft came in contact with Delhi tower.
- At 144136 UTC - landing checklists were carried out by the operating crew.
- At 144242 UTC - PIC took over the controls from co-pilot.
- At 144258 UTC - ATC gave landing clearance for runway 27 and informed winds calm.
- At 144317 UTC - Auto Sync Call-out of 500 was heard in the cockpit.
- At 144324 UTC - Autopilot was dis-engaged (Autopilot disengage sound was heard).
- At 144326 UTC – PIC told co-pilot that Go-around button was pressed by the PIC inadvertently. The PIC kept on mentioning about the same for another 20 seconds. Meanwhile the co-pilot asked PIC to remain stable and was heard saying “right..right..right” to PIC. The PIC acknowledged and said “correcting...correcting...correcting”.
- At 144346 UTC – PIC asked co-pilot to select heading.
- At 144351 UTC - Auto Sync Call-out of 100 was heard in the cockpit.
- At 144352 UTC – Co-pilot was heard saying “stable...stable...stable”.

- At 144353 UTC – A beep sound was heard in the cockpit which was of momentary alarm sound when the power was reduced below the idle after the power lever lock was lifted.
- From 144355 UTC to 144401 UTC – Auto Sync call-out from 50 to 10 was heard in the cockpit.
- At 144402 UTC – Touch down sound was heard which was louder than usual, which implicates to a hard landing.
- At 144420 UTC – ATC gave taxi instructions to the operating crew. However, the PIC was continuously mentioning about the inadvertently pressed GA button to the co-pilot.
- At 144454 UTC – The PIC was heard mentioning about the “touched runway” light coming ON to co-pilot.
- At 144708 UTC – After landing checklist was carried out by co-pilot.
- At 145027 UTC - The co-pilot informed ATC that the aircraft is fully parked.
- At 145112 UTC – Shutdown checklist was carried out by the operating crew.
- At 145159 UTC – The PIC asked the cabin crew in-charge to send the AME on board to cockpit.
- Thereafter the PIC was heard discussing about the events with the on-board AME and informed company about the same.

### 1.11.2 Digital Flight Data Recorder

The DFDR readout was analyzed and following are the salient observations: -

At Radio Altitude 412 ft		
Sl. No.	Parameters	Values
1	Time	143222 Z
2	Autopilot	OFF

3	GA	Pressed
3	Pitch	U 1.2
4	Roll	R 0.4
5	Normal Acceleration	0.997
6	Vertical Speed	-720 ft/min
7	Magnetic Heading	273.3
8	Ground Speed	140
9	CAS	138
10	Flap	15
11	Propeller Speed	R 1019, L 1019
12	Power Lever	R 45.7, L 45.4
13	Torque	R 16, L 15.5

**At Radio Altitude 311 ft**

<b>Sl. No.</b>	<b>Parameters</b>	<b>Values</b>
1.	Time	144327 Z
2.	Autopilot	OFF
3.	Pitch	D 0.8
4.	Roll	R 2.9
5.	Normal Acceleration	0.931
6.	Vertical Speed	-1110 ft/min
7.	Magnetic Heading	275.1
8.	Ground Speed	140
9.	CAS	139
10.	Flap	15
11.	Propeller Speed	R 1020, L 1018
12.	Power Lever	R 45.6, L 45.1
13.	Torque	R 15.5, L 14

**At Radio Altitude 111 ft**

<b>Sl. No.</b>	<b>Parameters</b>	<b>Values</b>
1.	Time	144347 Z
2.	Autopilot	OFF
3.	Pitch	U 1.1
4.	Roll	R 0.3
5.	Normal Acceleration	1.032



6.	Vertical Speed	-510 ft/min
7.	Magnetic Heading	273
8.	Ground Speed	151
9.	CAS	146
10.	Flap	15
11.	Propeller Speed	R 1019, L 1019
12.	Power Lever	R 46.7, L 46.5
13.	Torque	R 23.5 , L 24

**At Radio Altitude 42 ft**

<b>Sl. No.</b>	<b>Parameters</b>	<b>Values</b>
1.	Time	144353 Z
2.	Autopilot	OFF
3.	Pitch	U 0.5
4.	Roll	L 2.5
5.	Normal Acceleration	1.095
6.	Vertical Speed	-1200 ft/min
7.	Magnetic Heading	272
8.	Ground Speed	150
9.	CAS	144.5
10.	Flap	15
11.	Propeller Speed	R 1027, L 1028
12.	Power Lever	R 48.6, L 47.3
13.	Torque	R 13.5, L 12.5

**At Radio Altitude 16 ft**

<b>Sl. No.</b>	<b>Parameters</b>	<b>Values</b>
1.	Time	144357 Z
2.	Autopilot	OFF
3.	Pitch	U 2.2
4.	Roll	L 1.9
5.	Normal Acceleration	0.997
6.	Vertical Speed	-780 ft/min
7.	Magnetic Heading	271.6
8.	Ground Speed	149
9.	CAS	142.5
10.	Flap	15

11.	Propeller Speed	R 1018, L 1017
12.	Power Lever	R 30.1, L 32.4
13.	Torque	R 2 , L 4.5
<b>At touchdown</b>		
<b>Sl. No.</b>	<b>Parameters</b>	<b>Values</b>
1.	Time	144359 Z
2.	Autopilot	OFF
3.	Pitch	U 6.3
4.	Roll	L 2.1
5.	Normal Acceleration	3.773
6.	Vertical Speed	+180 ft/min
7.	Magnetic Heading	271.8
8.	Ground Speed	145
9.	CAS	134
10.	Flap	15
11.	Propeller Speed	R 1065, L 1063
12.	Power Lever	R 33.1, L 34.8
13.	Torque	R -6.5, L - 6.5

### **1.12 Wreckage and impact information**

The aircraft made a hard landing on the runway and subsequently had a tail strike. The lower surface of aft centre fuselage scrapped with runway. The damage was confined to aft centre fuselage & its associated structural components (as discussed in Para 1.3). There was no disintegration of any part of the aircraft in air.

### **1.13 Medical and pathological Information**

Both pilots had undergone preflight medical check along with Breath Analyzer (BA) Test prior to the first flight and the same was negative i.e. not found under the influence of alcohol.

#### **1.14 Fire**

There was no fire after the incident.

#### **1.15 Survival aspects**

The incident was survivable.

#### **1.16 Tests and research**

Nil

#### **1.17 Organizational and management information**

M/s Spice jet Ltd. is a scheduled airline with a fleet of 27 Boeing 737-800 , 04 B737-900 (ER), 04 B737-700 & 11 B737 MAX aircraft along with 27 Bombardier Q-400 aircraft operating flights on domestic and international sectors. The Airlines Head Quarter is located at New Delhi. The Air operator permit of the Airlines was valid at the time of incident. The Company is headed by Chief Executive Officer assisted by a team of professional of various departments. The Flight Safety Department is headed by Chief of Flight Safety approved by DGCA. The Chief of Safety is senior management official who reports directly to the CEO.

M/s Spice jet has a full established Operations training facility for the pilots. The training facility for both Boeing pilots and Q-400 pilots has been setup at Delhi. The training facilities are headed by the senior vice president Operations who reports to Chairman directly. The Engineering training facility is established at Delhi for B737 aircraft and at Hyderabad for Q-400 aircraft.

## **1.18 Additional Information**

### **1.18.1 Tail Strike Incident of M/s Spice Jet Dash -8 Q 400 aircraft VT- SUH**

M/s Spice Jet Dash 8 Q 400 aircraft VT-SUH was earlier involved in the Tail Strike Incident during landing on 28.07.2013 at Tuticorin.

Quote

*“The probable cause of the incident is owing to improper handling of the flight & thrust controls by the First Officer while carrying out an unauthorized supervised landing on a Category C airport. The early reduction of power, high pitch attitude just prior to aircraft touchdown resulted into lower aircraft speed and tail strike.*

*Contributing factors to the incident are:*

- 1. Pilot’s failure to scan/monitor the flight instruments and take appropriate & early action to control the aircraft pitch attitude prior to touchdown on runway.*
- 2. Failure of the PIC to take over control from the Co-Pilot at an appropriate stage to correct the decaying speed while landing on the runway.*
- 3. Non-adherence to SOP.*

*There were two recommendations*

- 1. The airline shall re-emphasize that flight crew to strictly follow the laid down guidelines/ SOPs*
- 2. The airline shall emphasize on adequate flight crew briefings on relevant contents of Q 400 Flight Crew Operating manual (FCOM) so as the avoid Tail Strike / Tail scraped incidents.”*

Unquote

### **1.18.2 Tail Strike and Tail Strike Prevention of Dash 8 Q 400 aircraft**

Tail strike is an event in which the empennage of an aircraft strikes the runway. This can happen during takeoff of a fixed-wing aircraft if the pilot pulls up too rapidly leading to the rear end of the fuselage contacting the runway or during landing if the pilot raises the nose too aggressively.

Tail strike incidents require aircraft to be thoroughly inspected and repairs may be difficult and expensive if the pressure hull has been imparted. Inadequate inspections and improper repairs to damaged airframes after a tail strike have been known to cause catastrophic structural failure long after the tail strike incident following multiple pressurization cycles.

With the Q400, the use of Flap 15 for landing results in a margin of 1.9° between the nominal landing flare angle and the tail strike, compared to a margin of 3.9° when using Flap 35.

The reduced margin is a scientifically quantifiable hazard that is due to the design of aircraft. The Q400's fuselage length lowers its tolerance to excessive pitch on landing, and tail-strike will occur at attitudes of 6.9°-7.5°. However, tail Strike may occur at lower attitudes during heavy landings.

The Dash8 Q400 doesn't have a tail skid and only have a tail strike indicator. It is mainly meant for take-off tail skid protection/indication, not for a tail-on landing. Some other fixed wing aircraft are fitted with small tail wheels or tailskids to mitigate the effect of tail strikes.

The Aircraft Flight Manual (AFM) cautions Operators that a pitch attitude greater than 6° during the landing flare may result in aft fuselage contacting with the runway. These events have occurred at flap settings of both 15° and 35°.

The Aircraft Manual also states that if the sink rate is higher than desired, power will be required in the landing flare through touch down. The manual specifically states that pitch angles above 6 degrees must be avoided and sink rate should not be controlled by increasing the pitch angle.

### **1.18.3 Depth Perception due poor/low visibility during landing**

Judging vertical distance above the ground during the flare is crucial for a smooth and safe landing. In reference to the process of estimating height and movement, during the approach, round-out, and touchdown, vision is of prime importance. Furthermore, accurate estimation of distance is, besides being a matter of practice, dependent upon how clearly objects are seen.

The most critical visual tasks that pilots are presented with are the judgments involved in landing. These may be divided into three phases:

- Initial judgment of an appropriate glide slope.
- Maintenance of the glide slope during the approach.
- Ground proximity judgments before touchdown.

In reference to the role of vision during the flare, the aircraft appears to be descending towards the ground during a normal approach. However, as the aircraft transitions for landing, the ground appears to rise toward the aircraft. The transition from a descent attitude to level-off flight marks the beginning of the flare. During this transition, vision is of prime importance. It is reasonable to assume that pilots learn appropriate depth perception cues through experience even though the process may not be conscious.

Surface references or the natural horizon may at times become obscured by smoke, fog, smog, haze, dust, ice particles, or other phenomena, although visibility may be above Visual Flight Rule (VFR) minimums. This is especially true at airports located adjacent to large bodies of water or sparsely populated areas, where few, if any, surface references are available.

Other contributors to disorientation are reflections from outside lights, sunlight shining through clouds, and light beams from the airplane's anti-collision rotating beacon.

Haze can adversely affect depth perception and create an illusion of being farther from the runway as a result, the pilot will have a tendency to be low on the approach. Extremely clear air (clear bright conditions of a high altitude airport) can give the pilot the illusion of being closer to the runway as a result, the pilot will have a tendency to be high approach, which may result in an overshoot or go around. Penetration of fog can also create an illusion of pitching up and may cause for a steepened approach quite abruptly.

## **1.19 Useful or effective investigation techniques**

NIL

## **2. ANALYSIS**

### **2.1 Serviceability of the aircraft**

The aircraft had a valid Certificate of Airworthiness and a Valid Certificate of Registration on the day of incident. The scrutiny of the Airframe Log book revealed that as on 8<sup>th</sup> November 2017, the aircraft had completed 15591:31 Airframe hours and 15265 cycles. The aircraft is powered by two PW 150 A Engines. The left Engine S/N PCE-FA0836 had logged 14333.30 Hrs / 13818 cycles and the right Engine S/N PCE-FA0867 had logged 12735.43 Hrs / 12430 cycles. There was no snag reported on the aircraft prior to the incident flight. Prior to incident flight, the aircraft weight & balance was well within the operating limits.

The aircraft and its engines were maintained as per the Maintenance Programme consisting of calendar period/ flying Hours or Cycles based maintenance as per maintenance program approved by DGCA. The aircraft was last weighed on 19<sup>th</sup> February 2017 at Delhi. The weight schedule was prepared and duly approved by the O/o DDG (NR), DGCA, Delhi.

### **2.2 Weather**

The weather at the time of incident was low visibility of around 400 meters with calm winds.

### **2.3 Analysis of CVR & DFDR**

Both CVR & DFDR were analyzed and following are the salient findings:-

- As per CVR, during cruise the PIC handed over controls to co-pilot and took over controls from co-pilot at 1000 feet during descent.



- The Approach was stabilized till approaching minima.
- At 411 ft approaching minimums, Autopilot was disengaged and PIC pressed G/A button inadvertently.
- PIC took over manually and continued approach and continued visual with approach lights and PAPI's.
- Below 330 ft AGL, A/C ROD increased to above 1000 fpm resulting in A/C being below G/S but within G/S tolerance. To get back on G/S, PIC added power up to 25% at 300 ft.
- At 110 ft, AGL A/C was again on correct G/S but due to high-power setting and low ROD A/C went above G/S.
- Power fluctuated between idle to 25% during descent up to 27 ft short of touch down.
- At 27 ft, power was brought back for flare and touchdown. But PIC put power lever below flight idle resulting in high ROD.
- To arrest high ROD prior to touchdown pitch was increased.
- The aircraft made a hard landing with 3.77 G and pitch went around 6.3° deg which resulted in tail strike.
- There was no call out given by the co pilot regarding increased pitch and power settings during landing.

#### **2.4 Pilot Factor**

Both operating crew were qualified/authorized to carry out the flight. The PIC had a total flying experience of 2786 hours with 2539:30 hours on type (Q400 aircraft) and 470 hours as PIC on type. The co-pilot had total 921 hours with 692 hours on Q 400 aircraft. Both crew had sufficient rest before the flight. The PIC had handed over controls to co-pilot at 2000 feet after take-off from Jabalpur and took over the controls during descent at 1000 feet before landing at Delhi. The PIC was neither

an instructor nor authorized by company to hand over controls to co-pilot. The operating crew did not inform ATC about the tail strike which as per Aircraft Flight Manual, they are required to inform ATC and airport operations of the fuselage/runway contact.

## **2.5 Circumstances leading to the serious incident**

During approach for landing at around 500 feet AGL, crew got visual contact with runway and continued the approach. At around 411 feet AGL, the PIC disengaged the autopilot and simultaneously inadvertently pressed the GA button. As the GA button was pressed, the FD bars moved to 10° on Flight Director for go-around mode. The PIC disregarded the bar on Flight Director and continued approach visually. As the FD bars were showing GA pitch, the PIC had no reference other than approach lights & PAPI. During landing, there was high Rate of Descent and in order to reduce the decent, PIC increased power to maintain glide slope. During approach while over threshold of runway 27 the aircraft was above the glide slope and in order to correct the same, PIC reduced power. While reducing the power, the PIC lifted the lock of power lever and the power was reduced below flight idle. There was a momentary warning sound in the cockpit for the same. This reduction in power further increased the rate of descent. Due to low visibility prevailing at that time, the PIC had a depth perception and initiated flare very close to the runway by increasing the pitch attitude to 6.3°. This increase in pitch very close to the ground with high rate of descent resulted in hard landing with vertical acceleration of 3.77G and subsequent tail strike.

### **3. CONCLUSIONS**

#### **3.1 Findings**

1. The Certificate of Airworthiness, Certificate of Registration, Certificate of Flight Release of the aircraft was valid on the date of incident.
2. Both Pilots were appropriately qualified to operate the flight.
3. All relevant Airworthiness Directives, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engines were found complied with.
4. There was no snag reported in the aircraft prior to the incident flight.
5. The flight from Jabalpur was delayed by 02 hours and uneventful till landing at Delhi.
6. The weather at that time at Delhi was low visibility 400 meters with calm winds.
7. After take-off from Jabalpur, when at 2000 feet, the PIC handed over the controls to co-pilot and took over the controls at 1000 feet during descent to Delhi. The PIC was neither an instructor nor authorized by company to hand over controls to co- pilot.
8. The landing was carried out by the PIC and Co-pilot was Pilot Monitoring.
9. The aircraft was cleared for landing runway 27 by ATC.
10. At around 411 feet AGL, the PIC disengaged the autopilot and simultaneously inadvertently pressed the GA (Go Around) button. As the GA button was pressed, the FD bars moved to 10° on Flight Director.
11. The PIC disregarded the bar on Flight Director (FD) and continued approach visually. The pilot had no reference other than approach lights and PAPI.

12. During landing, there was high Rate of Descent (above 1000 fpm) and in order to reduce the decent, PIC increased power to maintain glide slope.
13. While over threshold, the aircraft was high (above the glide slope) and in order to correct the same, PIC reduced power. The power lever control lock was lifted and the power was reduced below flight idle.
14. Reducing the power below the flight idle further increased the rate of descent.
15. Due to low visibility prevailing at that time, the PIC had a depth perception and initiated flare very close to the runway by increasing the pitch attitude to 6.3°.
16. This increase in pitch very close to the ground with high rate of descent resulted in hard landing with vertical acceleration of 3.77G and subsequent tail strike.
17. While taxiing to the bay, PIC noticed the 'Touched Runway' warning light getting illuminated.
18. All passengers were deplaned normally. There was no injury to any of the occupant on board the aircraft and there was no fire.
19. The cockpit crew did not inform ATC about the incident.

### **3.2 Probable cause of the incident**

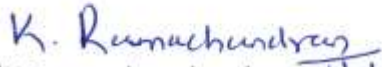
Un-stabilized approach due to improper handling of controls i.e. Inadvertent pressing of GA button and movement of throttle below flight idle resulted in heavy landing and subsequently tail strike.

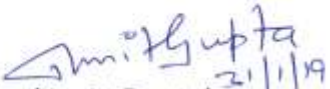
#### *Contributory factors*

- Error due to fixation to maintain Glide Slope.
- Depth perception due to low visibility.
- Not carrying out go around after inadvertently pressing GA button.

#### 4. SAFETY RECOMMENDATIONS

1. It is recommended that M/s SpiceJet may review their training programme for Q400 aircraft to emphasize on the landing techniques especially on tail strike prevention.
2. It is recommended that M/s SpiceJet may re-iterate necessary guidelines to crew to inform all such incidents to ATC.
3. It is recommended that M/s SpiceJet may issue necessary guidelines to the operating crew not to give controls to co-pilot without company authorization.

  
(K Ramachandran) 31/1/19  
Investigator

  
(Amit Gupta) 31/1/19  
Investigator – In – Charge

Date: 31.01.2019

Place: New Delhi